

# **DIGITAL CHLORIDOMETER**

**Models 4425000 (115V/60Hz)**

**Models 4425100 (115V/50Hz)**

**Models 4425150 (220V/50Hz)**

## **INSTRUCTION MANUAL**

Product designs are subject to change without notice

Form 00114630 Rev B / ECO B752

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### Clinical Sweat Chloride Testing Methods:

The suggested testing methods in this manual do not supercede the approved sweat testing methodology as published by the *National Committee for Clinical Laboratory Standards* (NCCLS). Please consult NCCLS document C34-A, Sweat Testing: Sample collection and Quantitative Analysis, Approved Guideline, for the proper clinical methodology.

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Thank you for displaying confidence in us by selecting a Labconco Digital Chloridometer. Our design engineers, assemblers and inspectors have utilized their skills and years of experience to ensure that the new Labconco Digital Chloridometer meets our high standard of quality and performance.

**IMPORTANT NOTICE**

All end users should read this manual carefully in order to become familiar with the operation of the Digital Chloridometer. Recommendations are made within the manual to help you obtain maximum performance and life from your product.

We have included sections on initial set up, operation, maintenance and troubleshooting to provide you with all the tools necessary to achieve maximum performance.

If you have questions or concerns, do not hesitate to call us at 1-800-821-5525 for assistance.

**Components Shipped**

Carefully check the contents of the carton for damage that might have occurred in transit. Do not discard the carton or packing material until all components have been checked against the following component list and the equipment has been setup and tested for proper operation.

As shipped, the carton should contain the following:

<b>Qty.</b>	<b>Catalog #</b>	<b>Description</b>
1	4425000	Digital Chloridometer, 115V/60 Hz, or
1	4425100	Digital Chloridometer, 115V/50 Hz, or
1	4425150	Digital Chloridometer, 220V/50 Hz
2	5860007	Sample Vials, 20 x 40 mm, Box of 100
1	4425064	Vial, Gelatin Reagent
1*	4425068	Bottle, Chloridometer Acid Reagent, 475ml
1	4425069	Bottle, Chloride Standard, 100 mEq/L, 120ml
1	4425080	Vial Rack
1	4425094	Jar, Silver Polish
1	4425095	Rinse Bottle, Plastic
1	4425079	Instrument Cover
1	0114630	Instruction Manual
1	5310020	1 Amp, 115VAC, Fuse
or	5310095	1/2 Amp, 220VAC, Fuse
1	4425198	Electrode Care Tag
1	5151001	Power Cord, 10A, 120V or
1	5151030	Power Cord, 10A, 220V

\*Shipments made outside the USA will receive 3 vials of Catalog No. 4425064 Gelatin Reagent in lieu of Catalog No. 4425068 Acid Reagent, as acid reagent requires shipment by ground transportation only.

## ***INTRODUCTION***

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### **General Description**

The Labconco Digital Chloridometer is a dedicated coulometric titrator designed to determine the chloride ion concentration of a solution. It displays this concentration in milliequivalents of chloride per liter when 10 micro-liter or 100 micro-liter samples are used. Some typical samples are serum, urine, biological extracts, food product extracts, industrial effluents and other aqueous solutions. The combination of silver ions and chloride ions is a quantitative reaction that results in an insoluble precipitate of silver chloride (AgCl). This reaction is carried out at a constant rate by passing a fixed direct current between a pair of silver electrodes immersed in an acid solution. The anode, which is consumed in this reaction, is a continuous spool of silver wire. As the immersed portion of the wire is consumed, fresh wire is drawn from the spool. As the equivalence point of the reaction is reached, an increase in current between a pair of separate indicator electrodes is detected. At a preset indicator current, the instrument automatically stops the incremental counter and the generation of silver ions. Since the generator current is constant, the titration time is directly proportional to the number of chloride ions that are introduced into the sample vial. The instrument displays this relative time in units of milliequivalents of chloride per liter.

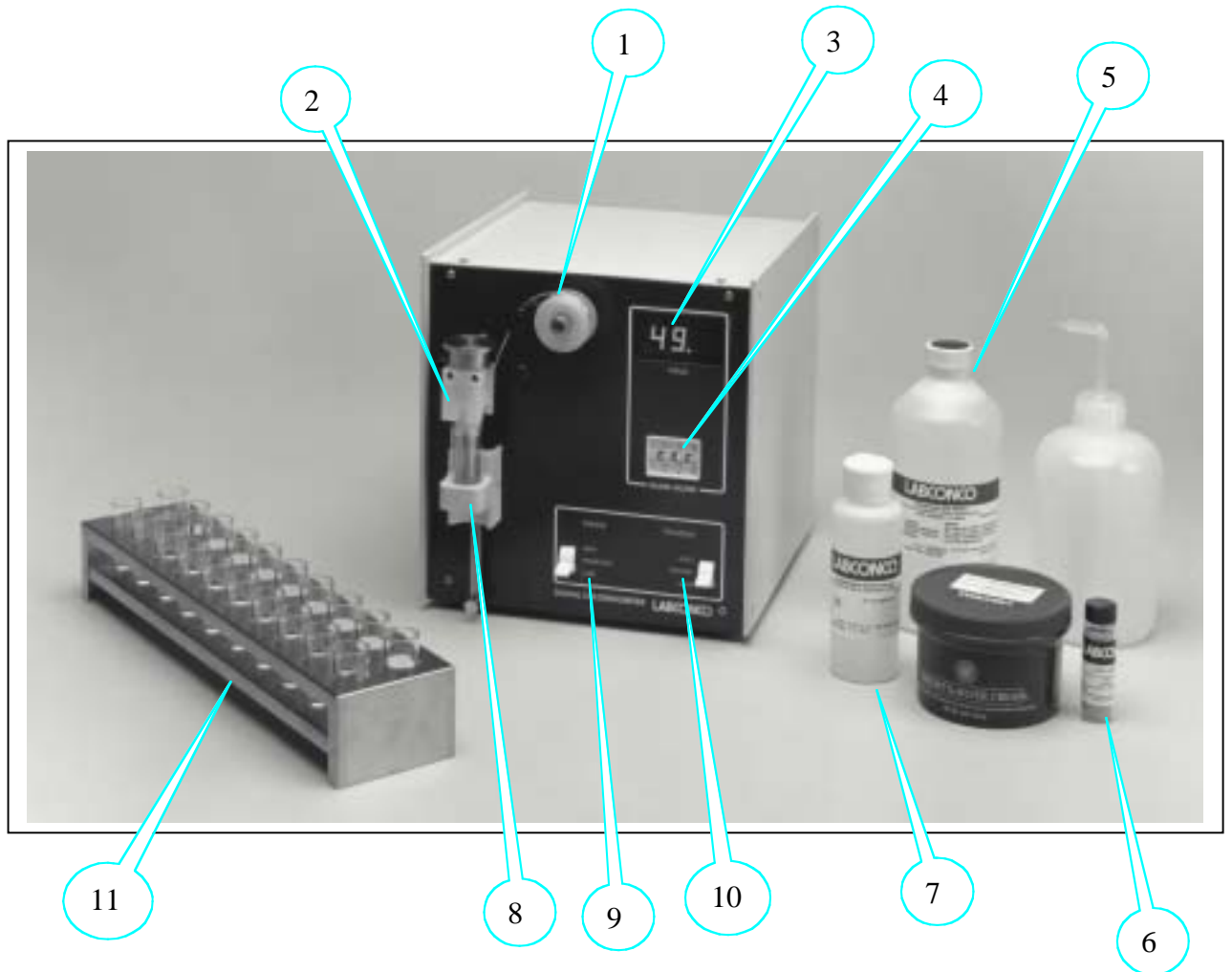
The Digital Chloridometer is an instrument requiring no special installation procedures. Simply connect the AC line cord to a grounded wall outlet and the instrument is ready for operation. No warm-up time is required.

### **Specifications**

Display Range:	1.0 to 999.9 mEq/L
Power Requirements	115 volts, 60 Hz
Power Consumption	30 watts
Reproducibility:	± 0.1%*
Accuracy:	± 0.5%*
Resolution:	1 mEq/L with standard 3-digit readout. 0.1 mEq/L with optional 4-digit readout (cover plate removed to expose fourth digit).
Titration Time:	Less than 20 seconds for 100 mEq/L concentration.
Sample Size:	10 µL on <b>LOW</b> range setting for direct reading 100 µL on <b>HIGH</b> range setting for direct reading
Display:	Digital, 3 or 4 digits, 5/8" high
Dimensions:	8-3/8" x 8-3/4" x 8-3/4" (212 mm wide x 222 mm high x 222 mm deep)
Net Weight:	10 lbs. (4.5Kg)
Shipping Weight:	15 lbs. (6.8Kg)

\*Generally limited by the sample dispensing system.

***DESCRIPTION OF UNIT & ACCESSORIES***



## *DESCRIPTION OF UNIT & ACCESSORIES*

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1. **SILVER WIRE** – A continuous spool of wire is the anode in the electrode assembly. The wire is consumed in the reaction and fresh wire is drawn from the spool.
2. **ELECTRODE ASSEMBLY** – Cathode and anode generate silver ions at a constant rate. A stirrer mixes the sample during titration.
3. **DIGITAL READOUT** – Directly displays from 1 to 999 mEq/L with an optional fourth digit 0.1 mEq/L.
4. **BLANK ADJUSTMENT** – 3-digit thumbwheel counter with correction maximum value of 99.9 mEq/L. When samples are titrated, one per vial, the background reading of the reagent solution may be automatically subtracted by setting the average blank reading on these thumbwheel switches. During this subtraction process, the display is blank.
5. **ACID REAGENT** – Complete reagent solution to which the sample is added for titration. Store at room temperature. Expiration date is printed on the bottle.
6. **GELATIN REAGENT** – Combined with acid solution, this reagent is used as a substitute for Acid Reagent, (which can only be shipped via ground transportation).
7. **CHLORIDE STANDARD SOLUTION** – Contains 100 mEq/L chloride ions  $\pm 1.0\%$ . This solution is used to verify the internal factory calibration of the unit. Also used to monitor continued calibration accuracy of the unit during use.
8. **VIAL HOLDER** – Raises and lowers the sample vials, introducing the sample to the electrodes and locking the vial in position.
9. **RANGE SELECTOR** – 3-position switch turns the unit **ON** and selects the appropriate current level for the sample volume. **HIGH** corresponds to 100  $\mu\text{L}$  samples and **LOW** corresponds to 10  $\mu\text{L}$  samples.
10. **TITRATION** – 3-position switch for Auto/Standby/Start. In **AUTO** position, the addition of each sample with a concentration greater than 30 mEq/L will automatically reset the display and begin a new titration. In **STANDBY** position, the switch must be momentarily depressed to begin a new titration.
11. **VIALS & RACK** – Included are 200 vials (20 x 40 mm) and rack, which has a capacity of 20 vials.
12. **STANDARD/COMPENSATE SWITCH** – A toggle switch on the back of the unit used to adjust manual calibration.

**CAUTION:** Suitable care must be exercised in the preparation and handling of acid solutions. See Preparations of Reagents.

### **Preparation of Reagents**

1. **Chloridometer Acid Reagent** – supplied ready to use. (Labconco reorder # 4425065).
2. **Chloride Standard Solution** – supplied ready to use. (Labconco reorder #4425066).

**NOTE:** The following steps are not required when using the pre-formulated Acid Reagent, but may be substituted for it.

3. **Acid Solution** – To 900 ml of distilled water, add 6.4 ml concentrated (69 – 70%) nitric acid and 100 ml of (99.7%) glacial acetic acid. Use reagent-grade chemicals only.
4. **Gelatin Reagent** – Heat one liter of distilled water to boiling, slowly empty the contents of one Gelatin Reagent vial into the water while continuously stirring until dissolved. The gel solution may be stored under refrigeration for up to six months or kept at room temperature for eight hours. For convenience, it is suggested that the gelatin solution be stored in small 10 mL vials. Add 4 drops to acid solution prior to titrating the sample. Once the gelatin is added, the solution will turn violet.

### **Electrode Cleaning and Conditioning**

1. With the instrument off, check that the generator electrode (silver wire spool) is the same length as the other electrodes and is thicker than the shaft of an ordinary straight pin. If it is not, snip off the thin segment and unwind enough wire from the spool to even its length with the other electrodes. Tighten the binding post (located to the left of the wire spool) so that it makes good contact with the silver wire. Do not put the wire through the hole in the binding post since this will deform the soft metal.
2. Thoroughly clean all four electrodes with silver polish, rinse with distilled water and buff with tissue. Be certain no residue remains between the indicator electrodes at their common mounting post. Avoid getting skin oils on the electrodes.
3. After cleaning, place a vial filled with 4 ml of Chloridometer Acid Reagent or 4 ml of prepared acid solution and 4 drops of dissolved Gelatin Reagent in the vial holder. Set the **RANGE** switch to **LOW**, the **TITRATION** switch to **AUTO** and raise the holder so that the electrodes are immersed as the stirrer begins.
4. If a reading does not appear after 30 seconds, re-rinse the electrodes and retitrate using a fresh vial. Do this until a reading is obtained.

### **Calibration**

1. Titrate several 100  $\mu$ L or 10  $\mu$ L samples of the 100 mEq/L standard solution in 4 mls of the acid reagent utilizing the **HIGH** or **LOW** range respectively.
2. If the results are consistently high or low, the display may be corrected to show the actual concentration by using the **STANDARD/COMPENSATE** switch on the rear of the unit.
3. Switch the toggle from **STANDARD** to **COMPENSATE** and adjust the knob. For each knob revolution, the reading is changed by 2.5% on 115V/60Hz units. 230V units are not available. Perform a new titration using the standard solution in order to determine the magnitude of each adjustment.
4. The toggle switch must remain in the **COMPENSATE** position for all future measurements to retain the effect of the manual calibration adjustment. If the compensation is no longer needed, return the toggle switch to the **STANDARD** position.

### **Display readings to 0.1 mEq/L**

**NOTE:** The Digital Chloridometer has been supplied with a three-digit display for reading to one mill equivalent resolution. We have found that in most clinical or quality control applications that this is sufficient resolution based on the limits imposed by dispensing accuracy and clinical standards. However, a fourth digit (0.1mEq/L) can be easily exposed on this instrument. We do not recommend that this procedure be followed for typical applications of the Chloridometer. It is provided for research applications requiring greater resolution.

To expose the fourth display digit:

1. Disconnect power to the device before performing the following steps.
2. Remove the top/back/bottom panel by loosening the screws on one side panel and removing the four screws on the top and bottom panel. The U-shaped housing will now slide off to the rear of the unit.
3. A one-inch wide strip of black metal is screwed to the supporting frame just above the front panel display window. Remove the screw and the strip to expose the fourth digit.

**Test Procedures**

**SERIAL TITRATION** – Appropriate for multiple samples with a minimum concentration of 30 mEq/L. Two methods may be used for serial titration:

**A. FIRST METHOD**

1. Pipette 4 ml of Acid Reagent or 4 ml prepared acid solution and 4 drops of dissolved Gelatin Reagent into the vials supplied with the unit.
2. Place the range switch in either the **LOW** or **HIGH** position for 10  $\mu$ L or 100  $\mu$ L samples respectively. When in the **LOW** position, more samples can be titrated per vial. Larger sample sizes increase accuracy.
3. Place the vial in the vial holder and slide it up until the electrodes are immersed.
4. Place the **TITRATION** switch to the **AUTO** position. Within a few seconds, the display will begin to count. The final reading corresponds to the blank reading of the solution and should be disregarded.
5. Keep the vial in the raised position and add 10  $\mu$ L or 100  $\mu$ L of sample. The addition of a sample with a chloride concentration greater than 30 mEq/L will automatically reset the display to zero and begin a new titration.
6. After the endpoint is reached and the number is recorded, a new sample may be added.
7. As the solution becomes whiter with precipitated silver chloride, the delay prior to titration will increase until ultimately a titration cannot be initiated.
8. Lower the vial, replace with fresh vial and after raising the new vial, proceed as described in step 4 above.
9. For each new vial, the titration procedure is the same. The electrodes need to be cleaned only if there are visible deposits. When the instrument is not in use, leave the electrodes immersed in distilled water and set the **TITRATION** switch to **STANDBY** or the **RANGE** switch to **POWER OFF**.

**B. SECOND METHOD**

1. Fill the sample vials in the same manner as described in step 1 above.
2. Place the **TITRATION** switch to **STANDBY**.
3. Select the appropriate range (**HIGH** for 100  $\mu$ L samples, or **LOW** for 10  $\mu$ L samples).

4. Place the vial in the vial holder and slide it up until the electrodes are immersed.
5. Depress the **TITRATION** switch to start the unit. The final value corresponds to a blank value, which is disregarded.
6. Lower the vial holder and add your sample.
7. Raise the vial and press the **TITRATION** switch to start to initiate the titration process.
8. The Digital Chloridometer will now display the value for the sample.
9. Lower the vial, add fresh sample and after raising the vial, depress the **TITRATION** switch to start the unit.

## **INDIVIDUAL TITRATION**

### **Blank Determination**

1. Place **TITRATION** switch in **STANDBY**.
2. Select the appropriate range for the sample volume to be used.
3. Fill each of four vials with 4.0 ml of Acid Reagent or prepared acid solution plus four drops of dissolved Gelatin Reagent.
4. Consecutively place each vial on the vial holder, raise the holder and depress the **TITRATION** switch.
5. Compute the average of the four blank determinations and enter that number on the **BLANK** thumbwheel switch. If the blank is greater than 100, enter the blank value minus 100 on the thumbwheel switch and subtract 100 manually for all determinations.
6. Place 100  $\mu\text{L}$  or 10  $\mu\text{L}$  of sample in a vial containing 4.0 ml of fresh Acid Reagent or prepared acid solution with 4 drops of dissolved Gelatin Reagent.
7. Place the vial on the vial holder, rise into position and depress the **TITRATION** switch. The averaged blank chloride value will be automatically subtracted and the reading displayed will be the chloride concentration of the sample.

**Measurements of Very High and Low Chloride Concentrations**

**LOW CHLORIDE CONCENTRATION** – For enhanced resolution and accuracy, titrate 100 µL samples on the **LOW** range and move the decimal point in the displayed reading one place to the left.

**HIGH CHLORIDE CONCENTRATION** – For greater measurement speed and/or enhanced readout capability, titrate 10 µL samples on the **HIGH** range and shift the decimal point one place to the right. The same manipulation may be done with other sample sizes as long as the display reading is corrected. For example, if 200 µL is added on the **LOW** range (20 times the volume the instrument expects to receive) the display reading will have to be divided by 20.

**NOTE:** If the **RANGE** switch is changed during serial titrations, the first reading after the range is changed will be incorrect. This is due to an over-titration time difference (proportional to the amount of silver ions generated before the sense circuitry stops the counter) between the **LOW** and **HIGH** ranges. All readings after this transitional one will be accurate.

**VERY LOW CHLORIDE CONCENTRATIONS** – For very low concentration samples that read less than 30 mEq/L even when 100 µL of sample is added on the **LOW** range (a reading of 30 in this case would be equivalent to 3 mEq/L), more sample must be added. Since the blank time and over-titration time are related to total volume, the combination of sample and reagent should closely approximate 4 ml for a single test.

In this case a 4 times more concentrated (0.4 N HNO<sub>3</sub> and 40% glacial acetic acid) stock solution should be prepared as follows: 250 ml distilled water is added to a clean, 500 ml volumetric flask. To this, add 12 ml concentrated nitric acid (69-70%) and then 200 ml glacial acetic acid. Bring the total volume to 500 mL with distilled water. The solution will then be diluted to the standard 0.1 N HNO<sub>3</sub> 10% CH<sub>3</sub>COOH solution using sample and/or distilled water in the sample vial.

**Example:** 3 ml of an unknown is to be titrated on the **LOW** range (300 times the normal volume).

First obtain an average blank value using 1 ml of the 4X concentrated acid solution, 3 ml distilled water and 4 drops of dissolved gelatin. Enter the blank number in the **BLANK ADJUSTMENT** switches. Now, add 1 ml of the 4X concentrated acid solution and 4 drops of dissolved gelatin to 3 ml of the unknown. Titrate this sample in the normal manner and divide the final readout by 300.

## **OPERATING INSTRUCTIONS**

Typical conditions for measuring low concentration of chloride over more than a hundred fold range are as follows:

### **ANTICIPATED CONCENTRATIONS\* mEq/L**

		<b>0.05 – 0.9</b>	<b>0.9 – 5</b>	<b>5 – 30**</b>
Conditions	Blank	1.8 – 32	33 – 177	177 – 1065 ppm
ml Sample	0	3.0	0.5	0.1
ml .4N HNO <sub>3</sub>				
40% CH <sub>3</sub> COOH	1.0	1.0	1.0	1.0
drops dissolved gelatin	4	4	4	4
ml distilled H <sub>2</sub> O	3	0	2.5	3.0
total volume	4.0	4.0	4.0	4.1
display reading	-	15 – 270	45-250	50 – 300
correction factor	--	1/300	1/50	1/10

\*Assumes using **LOW** range in all cases.

\*\*Concentrations in this range can use the serial titration procedure (page 12) and the standard acid solution.

### **CORRECTION FORMULA FOR CONVERTING DISPLAY UNITS**

For solid Samples: mEq Cl<sup>-</sup>/L to % NaCl:

$$\% \text{NaCl} = \frac{(\text{reading})(5.85)(\text{final sample volumes, liters})}{\text{original sample weight, grams}}$$

This assumes a known weight of a solid sample has been mixed in a known final volume of solution.

For liquid samples:

$$\% \text{NaCl} = \frac{(\text{reading})(5.85)(\text{final sample volumes, liters})}{(\text{sample volume, liters})(\text{density g/l})}$$

mEq Cl<sup>-</sup>/L to mg NaCl/L: mg NaCl/L = (reading) x (58.5)

mEq Cl<sup>-</sup>/L to ppm Cl<sup>-</sup>: ppm Cl<sup>-</sup> = (reading) x (35.5)

Example:     1 mEq Cl = 35.5 ppm  
              10 mEq Cl = 355 ppm

The following conditions can contribute to an error in the Chloridometer readout:

1. An error in sample volume is the most common source of an inaccurate reading. New operators should familiarize themselves with pipetting into the small vial by performing serial titrations with a standard salt solution. The measure of reproducibility obtained will establish confidence in the technique or suggest areas of pipetting improvement.
2. Bromide and iodide will combine with silver in the same manner as chloride and cannot be differentiated by the Chloridometer. The Chloridometer actually reads the total concentration of  $\text{Cl}^-$ ,  $\text{Br}^-$  and  $\text{I}^-$ .
3. Be certain that the electrodes and vials are clean and that the generator electrode is of the proper length and is securely connected to the binding post.
4. Very high protein to chloride concentrations can slightly elevate readings.
5. If the toggle switch on the rear of the unit is in the **COMPENSATE** position, the reading may be in error (refer to Calibration section of this manual).
6. Discard any prepared gelatin solution that has remained at room temperature for more than eight hours or that has been refrigerated for longer than six months.

### **Basic Electronic Validation**

In order to determine that the Digital Chloridometer is functioning properly, the following checks should be made:

1. Place the **RANGE** switch in **HIGH** position and the **TITRATION** switch in the **AUTO** position.
2. Set the **BLANK ADJUSTMENT** switches to 00.0.
3. Raise the empty vial holder. The stirrer should start rotating and in approximately four seconds the readout should start counting.
4. Short the two sensing electrodes located on the left side of the electrode assembly by using a jumper wire or the blade of a screwdriver. This should cause the readout to stop counting. Removing the short will cause the counter to immediately reset to zero and begin counting again.
5. Set the **BLANK ADJUSTMENT** switches to 60.0 for instruments powered by a 60 Hz AC line.
6. Place the **STANDARD/COMPENSATE** switch located on the back of the unit, in the **STANDARD** position.
7. Short the sensing electrodes again. Removing the short will now cause the display to go blank for precisely ten seconds and then resume counting.

## ***ROUTINE MAINTENANCE***

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Do not clean the unit with organic solvents or abrasive cleaners. Instead use mild detergent or soap. Do not allow the plastic portion of the electrode assembly to be immersed in the acid solution during titration. If the electrode assembly becomes damaged or deteriorated past the point of reliable operation, it may be replaced by simply unplugging the old assembly and plugging in a new one. Refer all electrical service problems to qualified service personnel. To quickly screen the instrument for any electronic problems, refer to the Basic Electronic Validation procedure. The only maintenance required for the Digital Chloridometer beyond general cleanliness is occasional polishing of the electrodes and immersion of the electrodes in distilled water when the unit is temporarily not in use.

# WARRANTY

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## Warranty

Labconco provides a warranty on all parts and factory workmanship. The warranty includes areas of defective material and workmanship, provided such defect results from normal and proper use of the equipment.

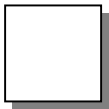
The warranty for all Labconco products will expire one year from date of installation or two years from date of shipment from Labconco, whichever is sooner, except the following:

- Purifier® Delta® Series Biological Safety Cabinets carry a three-year warranty from date of installation or four years from date of shipment from Labconco, whichever is sooner.
- Carts carry a lifetime warranty.
- Glassware is not warranted from breakage when dropped or mishandled.

This limited warranty covers parts and labor, but not transportation and insurance charges. In the event of a warranty claim, contact the dealer who sold you the product. If the cause is determined to be a manufacturing fault, the dealer will repair or replace all defective parts to restore the unit to operation. Under no circumstances shall Labconco Corporation be liable for indirect, consequential, or special damages of any kind. This statement may be altered by a specific published amendment. No individual has authorization to alter the provisions of this warranty policy or its amendments. Lamps and filters are not covered by this warranty. Damage due to corrosion or accidental breakage is also not covered.

## Limitation of Liability

The disposal and/or emission of substances used in connection with this equipment may be governed by various federal, state, or local regulations. All users of this equipment are required to become familiar with any regulations that apply in the user's area concerning the dumping of waste materials in or upon water, land, or air and to comply with such regulations. Labconco Corporation is held harmless with respect to user's compliance with such regulations.



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## ***SHIPPING DAMAGE CLAIMS***

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If a shipment is received in visibly damaged condition, be certain to make a notation on the delivering carrier's receipt and have their agent confirm the damage on your receipt. Otherwise, the damage claim may be refused.

If concealed damage or pilferage is discovered, notify the carrier immediately and retain the entire shipment intact for inspection. Interstate Commerce Commission rules require that the claim be filed with the carrier within 15 days after delivery.

NOTE: Do not return goods. Goods returned without prior authorization will not be accepted. Labconco Corporation and its dealers are not responsible for shipping damage. The recipient must file claims directly with the freight carrier. If authorization has been received to return this product, by accepting this approval, the user assumes all responsibility and liability for biological and chemical decontamination and cleansing. Labconco reserves the right to refuse delivery of any products, which do not appear to have been properly cleaned and/or decontaminated prior to authorized return.

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